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US-PAT-NO: 5760397
DOCUMENT-IDENTIFIER: US 5760397 A

TITLE: Millimeter wave imaging system

DATE-ISSUED: June 2, 1998

INVENTOR-INFORMATION:

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US-CL-CURRENT: 250/332; 250/336.1, 342/179

CLAIMS:

What is new and desired to be protected by letters patent of the United States is:
1. A method of forming an image from millimeter waves, comprising the steps of:

receiving millimeter wave signals from a field of view at a first surface of a transreflector plate;
using said transreflector plate to filter said received signals to pass signals having a preselected polarization;
reflecting and rotating said polarized signals with a load switching twist reflector;
reflecting said rotated polarized signals from a second surface of said transreflector plate;
receiving said reflected rotated polarized signals at a radiation detector assembly;
scanning said load switching twist reflector to redirect said reflected rotated polarized signals onto said radiation detector assembly; and
processing said reflected rotated polarized signals received by said radiation detector assembly to generate a first image.
2. The method of claim 1, wherein said scanning step is performed using positioning means for moving said load switching twist reflector.
3. The method of claim 2, wherein said positioning means are piezoelectric transducers.
4. The method of claim 1, 2 or 3, further comprising the step of providing multiple sets of image data for each scan of said load switching twist reflector.
5. The method of claim 1, 2 or 3, further comprising the step of adjusting the distance between said transreflector plate and said load switching twist reflector to focus said reflected rotated polarized signals received at said radiation detector assembly.
6. The method of claim 5, wherein said adjusting step is performed using an ultrasonic detector.
7. The method of claim 6, further comprising the step of band pass filtering said signals received from said field of view to pass signals within a preselected band.
8. The method of claim 7, wherein said preselected band is in the range 30 GHz to 300 GHz.
9. The method of claim 8, further comprising the step of focusing said band

pass filtered signals with a lens.
10. The method of claim 9, wherein said radiation detector assembly is an array of radiation detectors.
11. The method of claim 10, further comprising the steps of receiving a local oscillated signal at said radiation detector assembly and heterodyning said reflected rotated polarized signals with said local oscillated signal.
12. The method of claim 11, further comprising the steps of generating a noise signal and receiving said noise signal at said radiation detector assembly.
13. The method of claim 12, further comprising the step of converting said reflected rotated polarized signals to digital signals representative of the amplitude of said signals.
14. The method of claim 13, wherein said locally oscillated signal is generated by a plurality of signal generators.
15. The method of claim 14, wherein said plurality of signal generators are locked in phase by injection locking.
16. The method of claim 15, wherein said preselected band is approximately 94 GHz and wherein the frequency of said locally oscillated signal is approximately 47 GHz.
17. The method of claim 16, wherein said load switching twist reflector changes the polarization of said polarized signals from linear to circular.
18. The method of claim 16, wherein said load switching twist reflector rotates the linear polarization of said polarized signals by ninety degrees.
19. The method of claim 1, further comprising the steps of generating a second image with a camera and displaying said first image and said second image.
20. The method of claim 19, wherein said first and second images are displayed on the same display device.
21. A millimeter wave imaging system, comprising:
a millimeter wave bandpass filter;
a transreflector having a polarized filtering first surface and a reflective second surface;
a layered load switching twist reflector having a reflecting layer and a polarization rotating layer;
means for moving said load switching twist reflector;
a radiation detector assembly; and
means for forming a first image from signals received by said radiation detector assembly;
wherein said millimeter wave bandpass filter passes signals within a predetermined frequency, said first surface of said transreflector filters said bandpass filtered signals to pass signals of a predetermined polarization, said layered load switching twist reflector reflects and rotates said polarized signals, and said second surface of said transreflector reflects said rotated polarized signals; and wherein said radiation detector assembly receives and processes said reflected rotated polarized signals.
22. The imaging system of claim 21, wherein said means for moving comprises positioning elements mounted to said load switching twist reflector.
23. The imaging system of claim 22, wherein said positioning elements are piezoeletric transducers.
24. The imaging system of claim 23, further comprising spherical bearings for mounting said piezoelectric transducers to said load switching twist reflector.

25. The imaging system of claim 24, further comprising adjustment means for adjusting the distance between said transreflector and said load switching twist reflector.
26. The imaging system of claim 25, wherein said adjustment means includes an ultrasonic emitter and detector and means for moving said radiation detector assembly in response to the output of said ultrasonic emitter and detector.
27. The imaging system of claim 26, further comprising a lens, wherein said lens focuses said band passed signals.
28. The imaging system of claim 27, further comprising a local oscillator having an output antenna directed toward said radiation detector assembly.
29. The image system of claim 26, further comprising a camera for generating a second image and means for simultaneously displaying said first and second images.
30. The image system of claim 29, wherein said display means is a single display device.
31. The image system of claim 29, wherein said camera is spatially located within said bandpass filter.
32. The image system of claim 31, wherein said camera is spatially located at the center of said bandpass filter.

33. The imaging system of claim 21, wherein said predetermined frequency is in the range of 30 GHz to 300 GHz.